# REGIONAL CLIMATE & GREEN ENERGY

Climate change is expected to result in new norms of temperature, precipitation, wind, and other factors. At the macro scale, higher temperatures can be expected to increase productivity of current photovoltaic panels. But high temperatures can also reduce the efficiency of silicon panels. Today's wind turbines too are designed to optimize energy harvesting under current norms. How will they react under the increased stress of more extreme weather events?

Long-term investment decisions on these alternative energy systems is made on the meso-climactic scale (1-100 km). Air movement and cloud cover at this scale are impacted by the interplay of large-scale weather patterns with surface features such as hills, water bodies, urban areas, and vegetation cover.

In order to plan for use of renewable energy resources, it is critical to know their reliability. How often are winds in the ideal range of speeds to efficiently generate energy using wind turbines? How does the wind change from the bottom to the top of blades (a source of stress on turbines) in various locations in the Midwest and Illinois? How frequently do extremes in wind speed, including those that can damage turbine equipment, occur throughout the year? Can we accurately measure forces exerted by winds and how far into the future can we accurately predict them?

Solar resources require answers to similar questions. How much do factors obscuring solar energy, such as haze and clouds, tend to decrease the magnitude of daily radiation reaching the surface? What are the microphysical characteristics of clouds that have the greatest impacts on solar radiation? How rapidly do haze and clouds tend to change? Are changes in cloud characteristics predictable? How far in advance?

Improvements in weather forecasting and climate modelling will make the optimal spatial siting and return on investment of renewable energy facilities more accurate for the life of the technology. For instance, while the efficiency of a PV panel naturally decreases year by year, the availability of sunlight could increase. The resulting total energy output and the effective life of the installation would have a bearing on the financial viability of a project.

A major consideration when planning out facilities for utilizing renewable energy sources is consideration of how much they will change in coming decades. Much has been learned about climate variability and its evolution with time, and how it impacts the changeability of temperature, rain and snow. We seek to improve our understanding of how climate changes will influence factors determining the effectiveness of the generation of wind and solar power.

The most direct impact of Earth's changing climate will be on the atmosphere. Therefore, renewable energy resources that depend on the state of the atmosphere may be most vulnerable to climate changes.

Renewable energy, especially using solar or wind resources, is a major strategy for halting the further buildup of greenhouse gasses.

Better understanding of how the changing climate will impact sources of renewable energy can provide more accurate predictions of the benefits and length of service of renewable energy investments.

**FOCUS AREAS**

Foundational Research

Emerging Issues

HEAL Laboratory

Community/Citizen Outreach

State Agency Engagement

# CLIMATE IMPACTS ON RENEWABLES

The U.S. Environmental Protection Agency estimates that the impacts of climate change will affect how much energy the U.S. produces, delivers, and consumes.

- Temperature – If the nation's climate warms by 1.8°F, the demand for energy used for cooling is expected to increase by about 5-20%, while the demand for energy used for heating is expected to decrease by about 3-15%.
- Warming is likely to increase summer peak electricity demand in most regions of the United States.
- A warmer climate may reduce the efficiency of power production for many existing fossil fuel and nuclear power plants because these plants use water for cooling.
- The impacts of climate change on wind and solar power is still a developing area of research due to the challenges involved in modeling wind and cloud cover changes at the necessary spatial and vertical scales.

**Strategic investments**

0.4 FTE climate researcher.

0.6 FTE Support programmer.